HIGHWAY DESIGN	Chapter GENERAL INFORMATION
	Subject Purpose of this Guidance Manual

PURPOSE OF THIS GUIDANCE MANUAL:

The purpose of this Highway Design Manual is to present detailed or descriptive design information for Kentucky road projects. This manual has been prepared to provide guidance to personnel of the Transportation Cabinet and primarily to the road designer. The guidance supplied in this manual is based upon Kentucky common practice and relies on guidance from other resources when practical.

This Highway Design Manual places an emphasis on flexibility. The goal is to be permissive by default and explicit where needed. Sufficient flexibility should encourage independent designs tailored to particular situations. New guidance and detail is added to this Highway Design Manual to cover some areas that have been historically lacking or vague. This manual should not supersede the application of sound engineering principles by experienced design professionals.

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HIGHWAY DESIGN	Chapter GENERAL INFORMATION
	Subject Highway Design Philosophy

HIGHWAY DESIGN PHILOSOPHY

The design philosophy presented in this manual is in harmony with the Federal Highway Administration's (FHWA) goal stated in "Flexibility in Highway Design" publication "to design highways that incorporate community values and are safe, efficient, effective mechanisms for the movement of people and goods". The designers' challenge is to balance our commitment to preserving and protecting the environmental and cultural values in our communities while also providing a highway facility that is safe and that provides the necessary mobility to insure economic opportunities and an improved quality of life.

Design is a key ingredient in the project delivery process and it is important to realize that the different functional components must work together to deliver projects. Environmental analysis, right of way acquisition, utility relocation, etc. are also key components of project delivery and each component must be considered in the project decision. The National Environmental Policy Act of 1969 (NEPA) is the backdrop for the Cabinet's transportation decision-making process. The NEPA process requires decision-makers to use a systematic and interdisciplinary approach. The environment should be given appropriate consideration with economic and technical considerations. We should consider the three E's, engineering, environment, and economics in all decisions. Highway designers should work with the different functional units to determine the best transportation decision.

There is much discussion throughout this manual about the roles of project development teams (PDT), project managers (PM), and the Central Office role. The Division of Highway Design is in place to participate and provide support for the PDT in the transportation decision-making process. The Division will ensure that processes and design decisions are followed appropriately. They will also provide special expertise to the teams.

As expectations for better, safer roads have increased, a growing awareness of community needs has also emerged. This has contributed to development of the concept of Context Sensitive Design (CSD), which is a key principle utilized by the Cabinet.

CSD is a way of thinking about projects and not just a process that utilizes different standards or merely makes aesthetic enhancements.

As stated in the U.S. Code Title 23 Highways, Chapter 1 Federal-Aid Highways, Subchapter I General Provisions, Section 109 Standards, in subsection (a):

> "Plans and specifications for each proposed highway project under this chapter provide for a facility that will--
>
> (1) adequately serve the existing and planned future traffic of the highway in a manner that is conducive to safety, durability, and economy of maintenance; and
>
> (2) be designed and constructed in accordance with criteria best suited to accomplish the objectives described in paragraph (1) and to conform to the particular needs of each locality."
>
> Title 23 Section 109 also provides for "a design for new construction, reconstruction, resurfacing (except for maintenance resurfacing), restoration, or rehabilitation of a highway on the National Highway System (other than a highway also on the Interstate System) may take into account, in addition to the criteria described in subsection (a)--
>
> (A) the constructed and natural environment of the area;
>
> (B) the environmental, scenic, aesthetic, historic, community, and preservation impacts of the activity; and
>
> (C) access for other modes of transportation."

Taking into account the Title 23 provisions in the decision-making process is integral to the successfully implementation of CSD. The designer must place the following project related qualities in the forefront of their decision making process:

- The project satisfies the purpose and need as agreed to by a full range of stakeholders. This agreement is forged in the earliest phase of the project and amended as warranted as the project develops.
- The project is a safe facility for both the user and the community.
- The project is in harmony with the community, and it preserves environmental, scenic, aesthetic, historic, and natural resource values of the area.

- The project exceeds the expectations of both designers and stakeholders.
- The project involves efficient and effective use of the resources (time, budget, community values) of all involved parties.
- The project is designed and built with minimal disruption to the community.
- The project is seen as having added lasting value to the community
- Communication with all stakeholders is open, honest, early, and continuous.
- A multidisciplinary team is established early, with disciplines based on the needs of the specific project, and with the inclusion of the public.
- A full range of stakeholders is involved with transportation officials. The purposes of the project are clearly defined, and consensus on the scope is forged before proceeding.
- The project development process is tailored to meet the circumstances. This process should examine multiple alternatives that will result in a consensus.
- The public involvement process, which includes informal meetings, is tailored to the project.
- The landscape, the community, and valued resources are understood before engineering design is started.
- A full range of tools for communication about project alternatives is used (e.g., visualization).

As a result of Context Sensitive Design principles, the designer should be flexible in decision-making concerning the design decisions made about each project. The PDT has the responsibility of weighing all the particulars of a given project, and making design decisions accordingly. Design decisions should consider equally safety, mobility, and preserving scenic, aesthetic, historic, environmental and community values. Design criteria shown in AASHTO's "A Policy on Geometric Design of Highways and Streets" is intended as a guide allowing flexibility to encourage independent designs. Ranges of values are the key in Green Book criteria, with the utilization of higher values in the ranges where social, economic, and environmental impacts are not deemed critical. Sound engineering judgment is to be used in situations where these impacts are more pronounced.

During the early project development or conceptual design process, we have key decision points where the project development team must come together and make decisions that will help determine the outcome of a project. These key decision points are in line with the NEPA decision-making process. We must realize that the product of the conceptual phase is a transportation decision with an approved environmental document based on an alternate and not

just the preliminary line and grade plans. There is only one product, the transportation decision documented in the environmental document and reflected in the engineering plans.

There are key points during the development of a project when the project team must come together and make decisions. To better accommodate this process, the following steps should be followed in the shared transportation decision-making process:

Purpose & Need
Purpose & Need of a project is a key decision point of the shared decision making process. The Purpose and Need provides the foundation for successful decision-making and the basis for the evaluation and comparison of reasonable alternatives. Each project will have a Purpose and Need agreed to by the project team that will be utilized to establish the scope of the required work. The scope describes the boundaries of the project and defines the expected project deliverables. The project team will also use this Purpose and Need to develop alternatives and to guide their decisions. For projects where the Division of Planning has completed studies, the project team should review, revise and adopt the Purpose and Need presented in the planning report, with consensus reached on any necessary modifications.

Range of Alternatives
The next key decision in the shared transportation decision-making process is to determine an area of study within which a range of alternatives that meet the Purpose and Need can be developed. At this point in the process, the design team (consultant or in house) presents a range of alternatives that meet the Purpose and Need of the project. Alternatives/corridors previously evaluated during the development studies conducted by the Division of Planning should be the beginning point. Alternatives/corridors that were eliminated during the development studies should not require further investigation and should not be reconsidered unless new data or conditions warrant such study. Key environmental features within the corridor should be identified and mapped before alignment studies commence. The project team may eliminate alternatives from further consideration with adequate supporting documentation. While a preferred alternative may stand out, the project team should resist making a recommendation until they understand all relevant impacts and issues.

Following the review of the alternatives, the Subject Matter Experts (SME) would then proceed with an evaluation of those alternatives left for consideration. SME's are those professionals that have specific expertise available to the project team within our various Divisions and through consultant contracts. For example, the

environmental SME's are the functional professionals responsible for completing the environmental baseline work. They are the biologists, archaeologists, noise & air experts and other professionals that evaluate the existing conditions and determine the possible environmental impacts. Project teams also receive subject matter expertise from Highway Design, Bridge Design, Right of Way & Utilities, Traffic, Operations, and Construction. While some of these SME's may be core members of the project team, each Division is responsible for responding with the necessary level of timely support and guidance when this expertise is not available at the District level. It is the responsibility of the Project Team and Project Manager to identify and request these services.

The SME will need to consider a corridor approach as opposed to a given alignment so that adjustments can be made to avoid or minimize impacts. They also need to remain involved in the decision-making process to insure impacts are considered, and offer suggestions on how to minimize or mitigate when necessary. Evaluation of the range of alternatives should also include preliminary information about the total project costs. The Project Team consists of members from the various functional areas of the Department of Highways. The input of these members should be solicited throughout the project development process.

The output from the range of alternatives phase should consist of the list of possible, practical and feasible alternatives that fulfill the Purpose and Need. The study area for each alternative should also be available.

Scope of Impacts

This is the next key decision point in the progression of alternative analysis and shared transportation decision-making. The SME's should present to the project team the results of their investigations, including the baseline studies and the corresponding impacts of each of the alternatives on the study area. They would also offer suggestions on the risk associated with moving forward with each alternative and the time frame involved in resolving identified impact issues; i.e. 4(f) involvement that could take an additional 12 months to resolve, the stream mitigation would cost $450,000 or there is a 10 inch gas main that will require relocation. Right of way professionals and utility agents would also present their findings during this meeting so that the project team can fully consider the possible impacts that property acquisition and utility location (both public and private) might have on the transportation decision.

When the SME has uncovered information that could have a significant impact to the budget and schedule of the project, the

SME and Project Manager will need to inform the project team so that other members can consider the impact that information may have on their decisions.

When determining the impacts, the project team must work through the decision making process which includes avoidance, minimization, mitigation, and possibly even enhancement efforts necessary to address the impact. The project team may brainstorm potential opportunities to avoid, minimize or mitigate these impacts considering environment, economics and engineering. The project team could also make decisions or determine that additional information is required to further investigate the alternatives. Then after that investigation, they would present their evaluation to the project team detailing the impacts/issues involved with each alternative. The project team would discuss and possibly determine a recommended alternative.

All decisions will be documented and included in the draft environmental document, which would subsequently be finalized, reviewed, and approved by FHWA. The output from the Scope of Impacts phase could include the draft environmental assessment or categorical exclusion, preliminary alternative plans, the right of way and utility impacts with associated costs, possible mitigation measures, and the corresponding project costs and schedule impacts. If public and resource agency involvement is determined to have been sufficient, the project team may identify a preferred alternate in the environmental document prior to conducting the public hearing.

Selected Alternative

Following the approval of the draft environmental document and the public hearing, the project team will select a preferred alternative based on environmental, economic, and engineering issues and public input. This is the final key decision point of shared transportation decision-making in the conceptual stage of the project. The final environmental document would then be prepared, reviewed, and approved by FHWA. The output would be the final approved environmental document and the selected alternate to proceed into Phase II Design.

The purpose of these key decision points is to ensure that the environmental and design processes are integrated. Historically, the design process has been “out in front” waiting on the environmental process. This created a seemingly endless reiterative loop of obtaining environmental information, modifying the design, further environmental investigations, and modifying the design again. The key decision points procedures ensure that the different entities are providing the necessary input to the project

team at the appropriate time to make the best possible transportation decisions. These new procedures weave our roles and responsibilities together on each project team to create a true, shared transportation decision-making process.

The project team has the flexibility to combine these key decision points on a project by project basis. Smaller projects may offer the opportunity to combine the Range of Alternatives and Scope of Impacts. However, some projects may require further discussion of avoidance, minimization, and mitigation and require opportunities for the project team to convene and discuss. We must understand that each of these decision points should be discussed and considered before a final decision is made. It is also important that all project team members are aware of the intent to combine the decision points and that SME's be prepared to concurrently address the issues associated with each decision point.

These key decision points must be a model for all projects and therefore should be included in the consultant contracts as scheduled milestones. The project team with the appropriate input from SME's must determine the time required for completing their respective responsibilities and set the schedule appropriately.

As stated before, the transportation decision-making process requires the different functional divisions within the Cabinet to work together. The Division of Highway Design is an integral part of this process and must work with the other divisions to insure projects are delivered.

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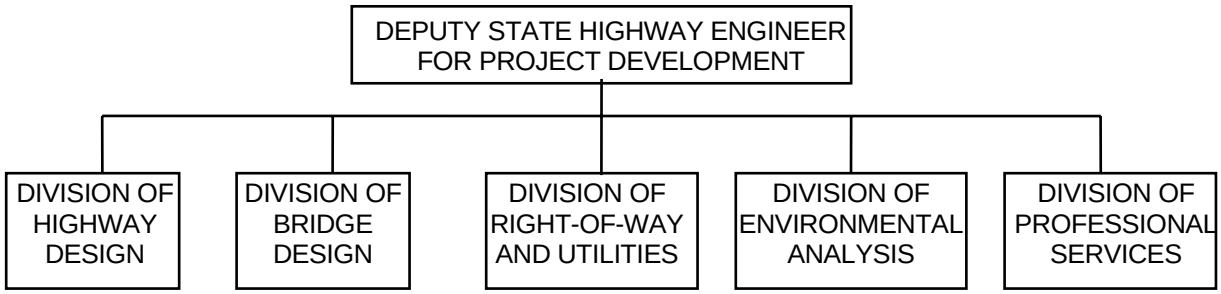
	Subject Organization

Summary: The organization structure of the Division of Highway Design is described.

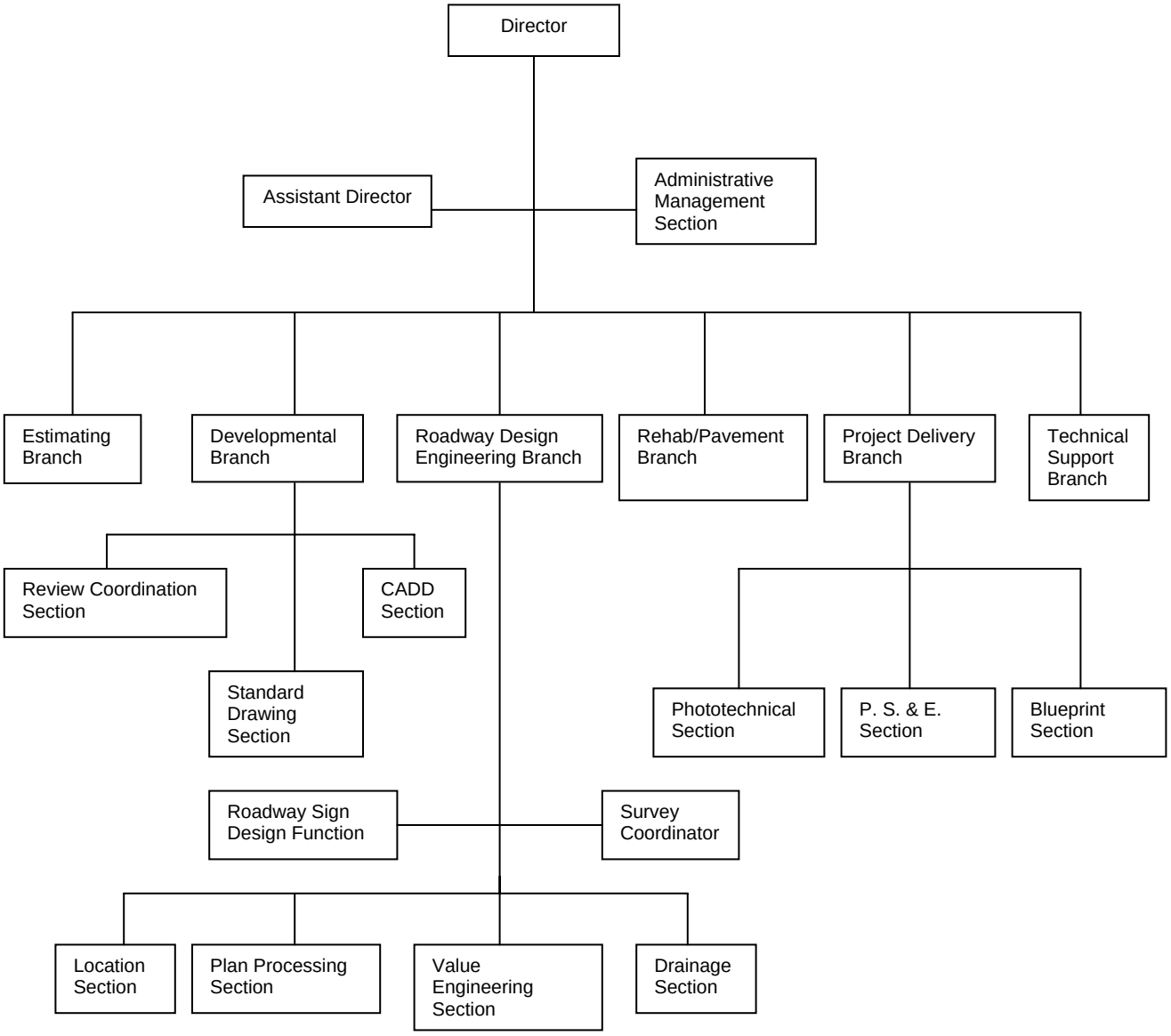
OVERVIEW:



The Division of Highway Design is one of five divisions under the responsibility of the Deputy State Highway Engineer for Project Development. The Deputy State Highway Engineers, under the direction of the State Highway Engineer and his Assistants, supervise the engineering functions of the Department. In addition, they plan and develop highway-engineering programs and recommend new and revised policies and procedures to the State Highway Engineer. They provide executive leadership and guidance to their functional areas.

The Division of Highway Design, in conjunction with the District Design Offices, is responsible for the required design activities for the Cabinet's Six-Year Plan projects. This includes conducting the studies, computations, and analyses necessary to support the preparation, assembly, and reproduction of the construction plans for a project's award.

The Division of Highway Design, Central Office Organizational Chart



CENTRAL OFFICE:

The primary responsibilities of the Division of Highway Design in the Central Office are:

(1) Develop criteria, procedures and policies for highway/roadway design,
(2) Ensure consistency of projects,
(3) Offer technical expertise and assistance to project managers, project teams, designers, and others associated with development and delivery of highway projects,
(4) Provide or facilitate opportunities for training as it relates to highway design criteria, procedures, and policy, and
(5) Deliver the final project to the letting process.

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The Central Office Division of Highway Design is divided into six branches: Project Delivery Branch, Developmental Branch, Roadway Design Engineering Branch, Rehabilitation and Pavements Branch, Estimating Branch, and the Technical Support Branch. The Director's Office includes the Director, an Assistant Director, and an Administrative Management Section.

Project Delivery Branch

The Project Delivery Branch supports the plan development process. It is divided into the PS&E (Plans, Specification, and Estimate) Section, the Phototechnical Section and Blueprint Section.

PS&E Section

The PS&E Section prepares and assembles the proposal package for the letting of all projects involving construction plans and for all projects requiring a PS&E package by the FHWA. PS&E staff also works with others (Operations /Maintenance, Rural Roads, etc.) to provide assistance in the preparation and assembly of proposals.

Phototechnical Section

The Phototechnical Section produces/reproduces aerial photographs for documentation, research, displays, and other related preconstruction engineering studies/activities. Photogrammetric mapping and aerial photographs are an integral aspect of any project development and are used to support alternate location studies as well as for development of displays and related materials that are used for Cabinet presentations and public meetings.

Blueprint (Reprographics) Section

The Blueprint (Reprographics) Section reproduces full-size and half-size plan sets for each construction letting. The number of projects varies from year to year and is

dependent upon the size of the highway construction program. The size of each plan set varies dependent upon the length and complexity of each project. With multiple copies of each plan set, the total number of plan sheets reproduced will number several thousands each year. In addition to reproductions for highway plan projects, the Blueprint (Reprographics) Section also reproduces large size plan sets for other Divisions within Transportation and also other state agencies.

Developmental Branch

The Developmental Branch is divided into three sections: the CADD (Computer Aided Drafting and Design) Section, the Standard Drawings Section, and the Coordination Section.

CADD Section

The CADD Section provides displays, studies, and reports as requested for the Secretary, State Highway Engineer, and others including highway studies for the Economic Development Cabinet. This section acts as a technical resource for the Director's Office and the Location Section by preparing studies and preliminary estimates. The CADD section also develops construction plans for unique or particularly challenging projects that may be assigned to the section. The CADD Section, using Six-Year Plan production projects and state of the art technology, works closely with the Technical Support Branch. They refine, develop and support the Department of Highways' CADD implementation effort by offering services on CADD equipment and applied operations training for users of highway design software and hardware.

Standard Drawings Section

The Standard Drawings Section provides special detail standard drawings and regularly updates the standard drawings utilized in construction plans. These standard details are made available to designers and project managers in the plan development phases and to construction engineers and contractors once a project is awarded.

The Section maintains a complete current file and index of roadway and traffic Standard Drawings converted to full-size reproducible plan sheets, and makes distribution for use on special projects. It maintains a history file on specific drawings and microfilms outdated drawings. It conducts research and investigation on new products, ideas, innovations and processes and prepares notes and

specifications when needed. It performs follow-up inspections on projects using newly developed design standards to determine any needed modifications or improvements. It checks shop drawings after projects are under construction. The Standard Drawings Section also prepares detail drawings on an as-needed basis for other sections.

Coordination Section
The Coordination Section processes Intergovernmental Reviews through the State Clearinghouse. They also work with project managers to provide technical assistance relative to the requirements for holding and documenting public hearings and meetings. Between 2000 and 2500 Review/Coordination documents are processed annually by the Coordination Section through the Statewide Clearinghouse. The documents include Intergovernmental Reviews, Environmental Reviews, Public Notices, and notices for non-Six-Year Plan projects. The number of Public Hearing/Public Meeting documents that are processed annually range between 80 and 100.

Roadway Design Engineering Branch
The Roadway Design Engineering Branch is divided into four sections: the Plan Processing Section, the Location Section, the Drainage Section, the Value Engineering Section. Roadway Sign Design and Survey Coordination are functions of the Roadway Design Engineering Branch.

Plan Processing Section
The Plan Processing Section works with project teams for final assembly and review of all projects at the time of letting to ensure that plans are complete and suitable for letting and that all notes and standard drawings are current.

Location Section
The Location Section provides technical support, budget and scope oversight, and liaison (Central Office to/from Districts) for project teams through all stages of design. This includes projects designed by the Department or by a consultant. Location Engineers are a primary resource for providing technical expertise and technical support for the project teams during all phases of design and plan development. The Location Section works on behalf of project managers and project teams to coordinate with outside agencies such as the Federal Highway Administration, other state agencies, and other divisions within the Department to facilitate design activities. Location Engineers participate in project team

meetings from the preliminary engineering phases through the final plan development phases.

Drainage Section

The Drainage Section reviews drainage design engineering details and calculations on most projects. The Drainage Section also reviews drainage permits, recommends corrections for drainage problems during construction and maintenance, and prepares the design on special drainage situations. Much of the review and technical assistance work done by the Drainage Section manifests itself in the findings of a "drainage folder" for each project. A project "drainage folder" summarizes the engineering and related drainage decisions that contribute to the design of each project.

Value Engineering Section

The Value Engineering Section conducts value-engineering studies on projects in compliance with Federal requirements. The Value Engineering Section also does constructability reviews at the near-completion stage of the design and plan preparation process to identify potential constructability issues that may be associated with a given project. Value engineering and constructability reviews currently are conducted on large-scale projects that typically are in excess of $25,000,000 construction costs. Post-construction reviews are conducted on a more frequent basis and are intended to identify design errors and related problems encountered during construction. This information is used to make refinements and modifications in design criteria and procedures for use with future projects.

Roadway Sign Design

The Roadway Sign Design function of the Roadway Design Engineering Branch provides for the design of signing plans for Interstates, Parkways and other high volume roads where panel signs are needed. The design process is completed either in-house or through a design consultant, with an in-house review of consultant designed plans, prior to inclusion into the final project plans. A primary objective is to assure that all sign plans comply with the Manual on Uniform Traffic Control Devices, the Roadside Design Guide and the Guidance Manual of the KYTC Division of Traffic Operations. When requested by the Project Manager, Roadway Sign Design will make final inspections of completed projects. Roadway Sign Design also administers the Statewide Sign Maintenance Agreement to assure that

all damaged panel signs and new or supplemental panel signs are promptly replaced or installed.

Survey Coordination
Survey Coordination works with the district survey crews to ensure that field procedures and survey data adhere to the current CADD standards. This function of the Roadway Design Engineering Branch is also in charge of the statewide Aerial Photography contract and is responsible for ensuring that all mapping for KYTC projects conforms with the CADD standards as well. All mapping requests come through this function of the division. In addition, a statewide surveying contract is handled under Survey Coordination. Survey Coordination works with NGS (National Geodetic Survey) to maintain statewide survey control networks such as the Kentucky Federal Base Network (FBN) and the National Geodetic Reference System (NGRS). The maintenance of these systems is an ongoing responsibility as well.

Rehabilitation and Pavements Branch
The Rehabilitation and Pavements Branch prepares, oversees, or reviews the preparation of pavement designs on all highway projects. This Branch is responsible for development of criteria and procedures used for design of pavements, including structural design, life-cycle cost analyses, analyses for pavement type selection, etc. This Branch also provides technical assistance with pavement design issues in other areas such as Construction, Maintenance, and Planning. This Branch also manages and coordinates the Department's programs for structural rehabilitation of pavements. This includes management of a statewide contract for design of pavement rehabilitation projects. In addition, this Branch is assigned direct design responsibility for many pavement rehabilitation projects on Interstates, Parkways, and other National Highway System routes. Staff from this Branch works with staff from the Federal Highway Administration, the Transportation Research Board, the American Association of State Highway and Transportation Officials, and the National Cooperative Highway Research Program in the development and refinement of structural design criteria and procedures for pavement designs.

Estimating Branch
The Estimating Branch, in accordance with KRS Chapter 176, prepares cost estimates for all publicly advertised highway construction projects that are competitively bid by the Transportation Cabinet. These estimates are referred to as the "Engineer's Estimates." The Engineer's Estimate represents a fair

and reasonable cost to construct a project with current material costs, labor rates and equipment costs.

The Estimating Branch provides data and analyses to the Awards Committee to facilitate their decisions regarding the award of competitively bid construction projects. This data is used to maintain a bid analysis database that is used to determine possible bidding irregularities.

Technical Support Branch

The Technical Support Branch supports the Department of Highways' statewide computerization effort in the project development area by offering services on CADD equipment and operations training for the Division of Highway Design and highway designers in the twelve District Offices. The CADD (Computer Aided Drafting and Design) Section works closely with the Technical Support Branch to facilitate the implementation of highway design software and hardware into the project design and development process.

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	Subject Design in District Office

Design in District Office:

The Transportation Cabinet has twelve (12) district offices spread throughout the state. The Chief District Engineer is responsible for all design functions performed by the district representatives, including the preparation of plans, surveys, and supervision of consultants. The responsibility of delivering a project to a letting is primarily the responsibility of the Project Manager. The Branch Manager for Pre-Construction is responsible for managing the preconstruction functional units in the District to support the Project Managers. As detailed above, the Division of Highway Design's primary function is to provide support for the highway design activities in the District Office. The Division of Highway Design is in place to participate and provide support for the PDT in the transportation decision-making process. The Division will ensure that processes and design decisions are followed appropriately. They will also provide special expertise to the teams.

The Chief District Engineer is responsible for the selection of the Project Manager and assembling the Project Development Teams. The PDT is comprised of cross-disciplinary functions from the District supplemented by Central Office subject matter experts. The Chief District Engineer should encourage representatives from each functional area under his supervision to participate on the PDT. The transportation decision-making process requires the utilization of a cross-disciplinary team and the PDT should be comprised of individuals from the different functional areas in the District and Central Office.

The District Design Office should be familiar with the design criteria established by the Department as well as the requirements of the Federal Highway Administration and the design guidelines contained in **AASHTO's** *A Policy on Geometric Design of Highways and Streets*, the *Roadside Design Guide*, and other technical documents contributing to the design process.